

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 5/06/2011 has been entered.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 5/06/2011 was filed after the mailing date of the Notice of Allowability on 4/01/2011. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Allowable Subject Matter

3. **Claims 30-34, 36-38, 40, 42-49, 94-95, 97-102, 120-121, 123-126 and 128** are allowed.

4. The following is an examiner's statement of reasons for allowance: After consideration of the documents cited on Applicant's IDS filed 5/06/2011, **claims 30-34, 36-38, 40, 42-49, 94-95, 97-102, 120-121, 123-126 and 128** remain allowable for the reasons discussed in the Office action mailed 4/01/2011 and reproduced below.

The prior art fails to teach or reasonably suggest:

an optical system, or an exposure apparatus or device fabrication method comprising the optical system, including an illumination optical system which illuminates a surface to be illuminated, the optical system comprising:

a birefringent element, disposed in an optical path of the optical system, that achieves a substantially circumferential distribution or a substantially radial distribution as a fast axis distribution in a lens aperture, the birefringent element is located at or near a position optically conjugate with the surface to be illuminated, in an optical path of the illumination optical system; and

an optical rotator disposed on an image side of the birefringent element and adapted to rotate a polarization state in the lens aperture.

Schuster (US 6,191,880, previously cited) teaches an optical system (fig.'s 5-6) including an illumination optical system 52-57 (taught with respect to a separate embodiment, fig. 5, col. 6 line 39-54 but also compatible with the projection system of fig. 6 as all components aside from radial polarizer 55 of the fig. 5 embodiment are conventional in lithographic apparatus, col. 6 lines 34-39) which illuminates a surface 58 to be illuminated, the optical system comprising:

a birefringent element 420, disposed in an optical path of the optical system (in the path of annular light beam 41, fig. 4a col. 5 lines 58-66), that achieves a substantially circumferential distribution or a substantially radial distribution as a fast axis distribution in a lens aperture (by centrally-symmetrical pressure stress, fig. 4c, col. 6 lines 2-11); and

an optical rotator 430 disposed on an image side of the birefringent element 420 and adapted to rotate a polarization state in the lens aperture (fig. 4d, col. 6 lines 21-24);

an exposure apparatus (fig. 6, col. 7 lines 13-25) comprising the optical system (birefringent element 420 and optical rotator 430 are located in radial polarization rotating optical arrangement 107, col. 7 lines 24-27) which effects exposure of a predetermined pattern (from reticle 101, analogous to reticle 58 of fig. 5) on a photosensitive substrate (having photoresist 109); and

a device fabrication method (microlithography, abstract) comprising:
preparing a photosensitive substrate (with photoresist 109); and exposing a pattern (from reticle 101, analogous to reticle 58 of fig. 5) to be transferred on the photosensitive substrate (having photoresist 109) through the optical system (fig. 6).

However, Schuster teaches that the feature which is critical to trouble-free functioning of birefringent elements is that they be located at a position of moderate angles of divergences of the light rays in an almost completely collimated beam path, such as a plane of the illumination or projection system which is Fourier-transformed to the image plane (col. 7 lines 33-42). Therefore Schuster not only fails to teach or reasonably suggest locating the birefringent element at or near a position optically conjugate to the surface 58, but explicitly teaches away from such a configuration, and one of ordinary skill in the art would not have been motivated to modify the apparatus and method of Schuster in the manner required by the independent claims.

Takeuchi et al (US 2007/0188730) teach an exposure apparatus (fig. 1, abstract) comprising a polarization adjuster 100 having a plurality of elements 102 arranged with a particular distribution of fast axes AD₁₋₅ (fig. 8 par. 61-62), but does not qualify as prior art and the particular fast axis distribution does not meet the limitations of the independent claims.

Stallinga et al (US 2009/0040160 corresponding to WO 2006/008691) teaches a method and apparatus for generating radially and azimuthally polarized light beams (fig. 5-7, abstract) comprising a birefringent element 22(52) which achieves a substantially circumferential or radial fast axis distribution and an optical rotator 56 disposed on an image side (wherein fast axis distribution is inherent to the properties shown in fig. 7 par. 38, circularly polarized incident light is converted to light having the distribution shown prior to entering optical rotator 56 to become radially polarized light), and the birefringent element 52 is disposed at or near a position which is optically conjugate to a surface 46 to be illuminated (fig. 5-6, par. 35 and 37, wherein the element 52 has a radially varying thickness to compensate for the incident angle variation of the convergent beam). However, Stallinga et al do not qualify as prior art.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COLIN KREUTZER whose telephone number is (571)270-7931. The examiner can normally be reached on Mon - Thurs from 9 AM - 4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Glick can be reached on (571)272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C. K./
Examiner, Art Unit 2882

5/19/2011

/Hung Henry Nguyen/
Primary Examiner of Art Unit 2882